DOSSIER: ASIA

Farmers are partners in research

Gordon Banta

An agronomist, an economist, and two farmers are standing in a rice field discussing what crop should be planted after the rice is harvested. The scene is typical of multiple cropping research today, as interdisciplinary research teams are moving out of research stations and into the farmers' fields to test and develop technology in the environment where it will be used.

The farmer thus becomes a partner in the research. Because he supplies the land and a major part of the labour, he may reject any idea that he feels will not help him.

The basic idea that separates cropping systems research from traditional agricultural research is that the farm is viewed as a total system. The emphasis is on crops, but the interactions with animal and household activities are taken into account — interactions that are impossible to duplicate on a research station. The goal is to make more efficient use of the farmer's total resources. This is usually achieved by growing additional crops, and by increasing the yield of existing crops.

In Southeast Asia over 80 percent of the farmers have less than three hectares of land. Rice is the predominant crop, and about 70 percent is grown under rainfed conditions, usually only one crop a year.

Northeast Thailand is a good example of a region where cropping systems research has potential. In a study of the region the Division of Agricultural Economics found that only 40 percent of agricultural labour was utilized in the wet season, while 13 percent of the fields were left unplanted.

In the current crop year peanuts, mungbean, maize and yard-long bean were grown successfully before rice. Then the rains failed, and several cooperator farmers lost most of their traditionally grown rice because they waited to puddle the land and transplant. By direct seeding, however, a second rice crop was produced after the first upland crop was harvested, this in a region that had been declared a disaster area by the government of Thailand.

It is expected that with varieties more suited to the local soil and rainfall patterns, most of Northeast Thailand could produce two crops per year, with a few areas having longer duration rainfall producing three crops in a good year.

It is in the area of better varieties, management and other technology that cropping systems research can have a major impact. Researchers working in the farm environment are able to feed back to central research institutions specific problems. If no solution to the problem is known, the specialist then has a new research project which he knows will have immediate impact on the farmers' ability to increase their well being.

Since only a few farmers are directly involved in the research, neighbouring farmers are watched to see if they adopt a new cropping pattern, and if so what modifications they make to it. Once this stage is reached, a workable package is available for extension.

Cropping systems work started at IRRI (the International Rice Research Institute) in 1968, and has received continuous support from IDRC since 1970. Today IRRI's cropping systems work is so widely accepted that there is an Asian Cropping Systems Network, comprising Bangladesh, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, and Thailand. People working directly in national programs meet every six months to compare results and discuss problems. Burma is also starting a program, and may join the network. South Korea, with its temperate climate, faces different problems, but nevertheless attends the meetings — research methodology can still be exchanged.

Each country in the network has a different set of problems, and the cropping systems programs at first seem quite different. In Indonesia one group is working on cropping patterns suited to new land in the transmigration areas. Sri Lanka has a team working on reviving rice production below the old tanks in the dry zone. Bangladesh is concerned with getting an extra crop in the deep water rice areas. Thailand is trying to get a second crop either before or after the rainfed rice crop on soils of very low fertility.

Each program is established by the national government to meet their specific needs and goals, yet in all these examples there is a common methodology which scientists share with other country programs. The Asian Cropping Systems Network is a good example of an Asian program, operated by Asians to solve Asian problems. □

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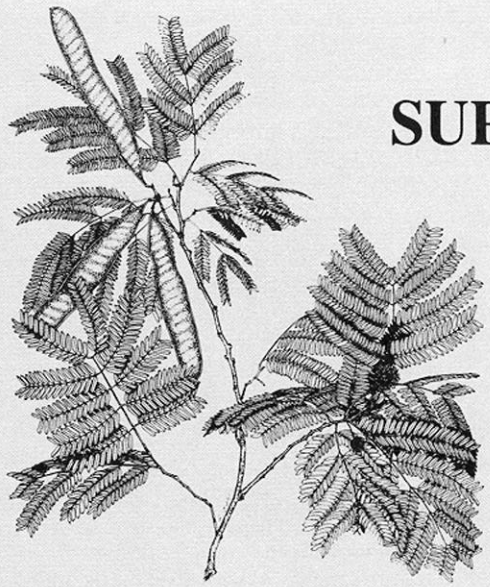

SUP

A tree that grows very rapidly, provides nutritious forage for animals, and yields firewood, timber, and fertilizer abundantly seems scarcely less than miraculous. The tree is leucaena (also known as leadtree, ipil-ipil, and koa haole), and although scientists are not prone to endorsing miracles, they do regard the potential of this tropical leguminous tree as "promising".*

The IDRC is supporting the Philippine Council for Agriculture and Resources Research (PCARR) in a project to develop the economic potential of leucaena for small landholders in the tropics.

In the Philippines, leucaena plantations have annually produced more wood than any other species now known. The tree leucaena resprouts vigorously from stumps, and can be harvested again in five to six years. The wood properties make it suitable for pulp and paper, and the manufacture of rayon and cellophane. The wood is strong, dense, and attractive, and has machining properties comparable to hardwoods used for commercial lumber and plywood. For the rural smallholder, leucaena can provide a ready source of roundwood for fence posts, rafters and joists for small buildings, and props for climbing and hanging crops after only two years.

Because the tree grows rapidly, yields well and will survive many cuttings, it may be ideal for firewood plantations or woodlots. Over half of all timber cut in the world is used for cooking or heating, and demand is rapidly outstripping supplies of traditional woods. Leucaena has an uncommonly high density and calorific value — good burning properties — and should be able to provide a reliable energy source for cooking, heating, and small industry. It may also supply the rural smallholder with additional income and employment oppor-

*The US National Academy of Sciences has recently published *Leucaena: promising forage and tree crop for the tropics*, available from the Commission on International Relations (JH 215), NAS/NRC, 2101 Constitution Avenue, Washington DC 20418, USA.

ER TREE?

Well, it's definitely promising . . .

Rowan Shirkie

tunities through the sale of wood and charcoal to urban areas.

Leucaena (pronounced loo-*see*-na) originated in Central America, and was spread to the Philippines and other countries in the western Pacific by Spanish traders several centuries ago. From the Pacific countries, the trees have spread throughout Southeast Asia and into Africa, until they are today found in almost all tropical countries. Two species are of most interest to scientists: a bushy shrub that averages about 5m at maturity, and a single-trunked tree species that matures in six years, reaching heights of up to 20m and diameter of 28cm.

Like most legumes, leucaena can form a mutually beneficial partnership with certain soil bacteria. The bacteria, known as *Rhizobium*, penetrate the young leucaena rootlets and multiply to create colonies in the form of nodules on the root surface. The bacteria absorb large amounts of nitrogen gas from the air in the soil and convert it to other nitrogen compounds that the plant can use for its own growth. Hence, leucaena requires little or no nitrogen fertilizer, and can thrive under soil conditions that would not sustain other crops. Its deep water-seeking tap root also gives the plant a measure of drought tolerance.

Besides "manufacturing" its own fertilizer, leucaena can provide essential nutrients for other plants as well. Many plants (and most trees) feed off the nutrients released in the soil by decaying vegetable material deposited there when other plants die or shed leaves. Deliberately adding plant matter to soils as fertilizer is called "green manuring". Leucaena is a rich green manure, providing nitrogen (its nitrogen contribution is especially high because of the *Rhizobium* activities), phosphorus, potassium, and calcium in significant amounts. As the increasing price and decreasing availability of petroleum-based fertilizers places them out of reach of small farmers, the value and use of leucaena as a renewable source of fertilizer will gain importance.

Researchers at PCARR, working in cooperation with the Forest Research Institute of the University of the Philippines, Los Baños, are studying the effects of leucaena green manure in experiments combining it with rows of sweet corn and rice. As a check, they will also use only chemical nitrogen fertilizer on a crop of the same size. An analysis of yields will give an indication of the comparative efficiency and economy of organic leucaena and commercial fertilizers.

Young leucaena is a forage that provides a valuable source of crude protein, vitamins and minerals for grazing animals. Yields of edible dry matter (leaves, flowers, pods, buds, and fine twigs) compare well with the best of conventional forage legumes such as alfalfa, but because of its nutritive and vigorous growth, leucaena can support more livestock on less land, and still produce high liveweight gains in meat animals and maintain good milk production in dairy animals.

In recent years some new varieties have been developed in Australia and Hawaii. Under favourable conditions these giant "super trees" have been known to produce annual yields of up to 24 tons per hectare. In Hawaii it has been shown that one hectare of leucaena interplanted with guinea grass can support at least three cattle. This is of particular importance to the Philippines, where 85 percent of the cattle are raised in twos and threes on small holdings. A great deal more research is needed, however, before the tree's full commercial potential can be realized.

One of the limitations of leucaena is that its foliage contains a toxic amino acid — mimosine — that can cause goitre and hair loss in animals fed high proportions of this forage over extended periods. However, simple management techniques to ensure a balanced diet, and research to develop strains of leucaena low in mimosine should eliminate this problem in future.

The PCARR project is aimed at overcoming some of leucaena's limitations, as well as exploiting its advantages. The tree has been limited previously because it grows best only in lowland areas below about 500m, and its exceptional yields occur only in fertile, well-drained soils where rainfall or irrigation is adequate. Like other legumes, leucaena requires a reasonable mineral balance in the soils on which it grows, but not enough is yet known about its requirements for sustained development. Seedlings grow slowly at first, leaving the tree vulnerable to adverse climatic conditions, weeds, and overgrazing. This period of vulnerability may make the tree crop somewhat difficult to establish. But once established, if it is not properly managed leucaena can become a nuisance, growing in dense and rank tangles.

Well aware of these limitations, the PCARR research team will attempt to develop their own improved strains of leucaena. They will collect a range of leucaena species, including some still growing wild in Central America. This genetic material will be used in a selection program aimed at identifying new strains with desirable characteristics such as low mimosine content, ability to adapt and grow well in a broader range of climatic and agronomic conditions, and rapid seedling growth. The research will also determine the plant's nutritional needs and its tolerance of adverse soil conditions, as well as developing new seeding and planting techniques to improve survival rates.

Gathering this detailed and specific knowledge about leucaena is a major step towards fulfilling the tree's promising potential. And the ultimate beneficiaries will be the small farmers of the region, who have long recognized the plant's usefulness: for them the "super tree" could bring a much needed increase in income, a steady source of fuel and fodder, and improved food production. □

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